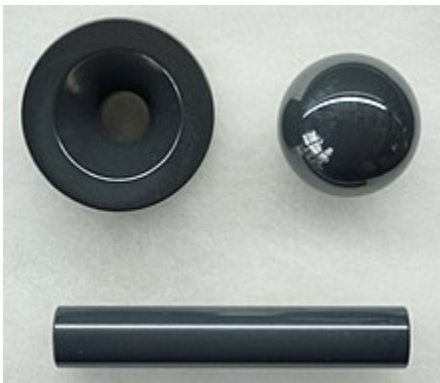


Sialon

SiALON ceramics are a specialist class of high-temperature refractory materials, with high strength at ambient and high temperatures, good thermal shock resistance and exceptional resistance to wetting or corrosion by molten non-ferrous metals, compared to other refractory materials such as, for example, alumina. A typical use is with handling of molten aluminium. They also are exceptionally corrosion resistant and hence are also used in the chemical industry. SiALONs also have high wear resistance, low thermal expansion and good oxidation resistance up to above ~1000 °C. They were first reported around 1971.^{[\[1\]](#)[\[2\]](#)}



α-SiAlON parts

Forms

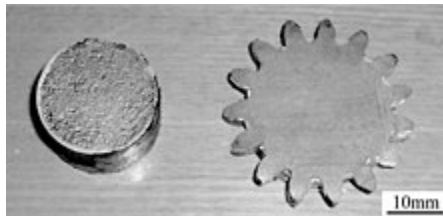
SiAlON forms^[3]

Form	formula	n	symmetry	space group	No	Pearson symbol	Z
α	$\text{Si}_{12-m-n}\text{Al}_{m+n}\text{O}_n\text{N}_{16-n}$		trigonal	P31c	159	hP28	4
β	$\text{Si}_{6-n}\text{Al}_n\text{O}_n\text{N}_{8-n}$	0–4.2	hexagonal	P6 ₃	173	hP14	2
O'	$\text{Si}_{2-n}\text{Al}_n\text{O}_{1+n}\text{N}_{2-n}$	0–0.2	orthorhombic	Cmc2 ₁	36	oS20	4

- m and n are the numbers of Al–N and Al–O bonds substituting for Si–N bonds

SiAlONs are ceramics based on the elements [silicon](#) (Si), [aluminium](#) (Al), [oxygen](#) (O) and [nitrogen](#) (N). They are solid solutions of [silicon nitride](#) (Si_3N_4), where Si–N bonds are partly replaced with Al–N and Al–O bonds. The substitution degrees can be estimated from the lattice parameters.^[3] The charge discrepancy caused by the substitution can be compensated by adding metal [cations](#) such as Li^+ , Mg^{2+} , Ca^{2+} , Y^{3+} and Ln^{3+} , where Ln stands for [lanthanide](#). SiAlONs exist in three basic forms, which are iso-structural with one of the two common forms of silicon nitride, alpha and beta, and with orthorhombic [silicon oxynitride](#); they are hence named as α , β and O'-SiAlONs.^[4]

Production



SiAlON gear (right) prepared from a billet (left) by forging at 1200 °C within 2 seconds.

SiAlONs are produced by first combining a mixture of raw materials including [silicon nitride](#), [alumina](#), [aluminium nitride](#), [silica](#) and the [oxide](#) of a [rare-earth element](#) such as [yttrium](#). The powder mix is fabricated into a "green" compact by [isostatic powder compaction](#) or [slipcasting](#), for example. Then the shaped form is densified, typically by [pressureless sintering](#) or [hot isostatic pressing](#). [Abnormal grain growth](#) has been extensively reported for SiAlON ceramics, and results in a bimodal grain size distribution of the sintered material. The sintered part may

then need to be machined by diamond [grinding \(abrasive cutting\)](#).^[3] Alternatively, they can be forged into various shapes at a temperature of ca. 1200 °C.^[5]

Applications



A variety of SiAlON phosphor powders under UV light

SiAlON ceramics have found extensive use in non-ferrous molten metal handling, particularly aluminium and its alloys, including metal feed tubes for aluminum die casting, burner and immersion heater tubes, injector and degassing for nonferrous metals, thermocouple protection tubes, crucibles and ladles.

In metal forming, SiAlON is used as a [cutting tool](#) for machining chill cast iron and as brazing and welding fixtures and pins, particularly for [resistance welding](#).


Other applications include in the chemical and process industries and the [oil and gas](#) industries, due to sialons excellent chemical stability and [corrosion resistance](#) and [wear resistance](#) properties.

Some [rare-earth activated](#) SiAlONs are [photoluminescent](#) and can serve as [phosphors](#). [Europium\(II\)-doped](#) β -SiAlON absorbs in [ultraviolet](#) and [visible light](#) spectrum and emits intense broadband visible emission. Its luminance and color does not change significantly with temperature, due to the temperature-stable crystal structure. It has a great potential as a green down-conversion phosphor for white [LEDs](#); a yellow variant also exists. For white LEDs, a blue LED is used with a yellow phosphor, or with a green and yellow SiAlON phosphor and a red CaAlSiN_3 -based (CASN) phosphor.^[4]

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